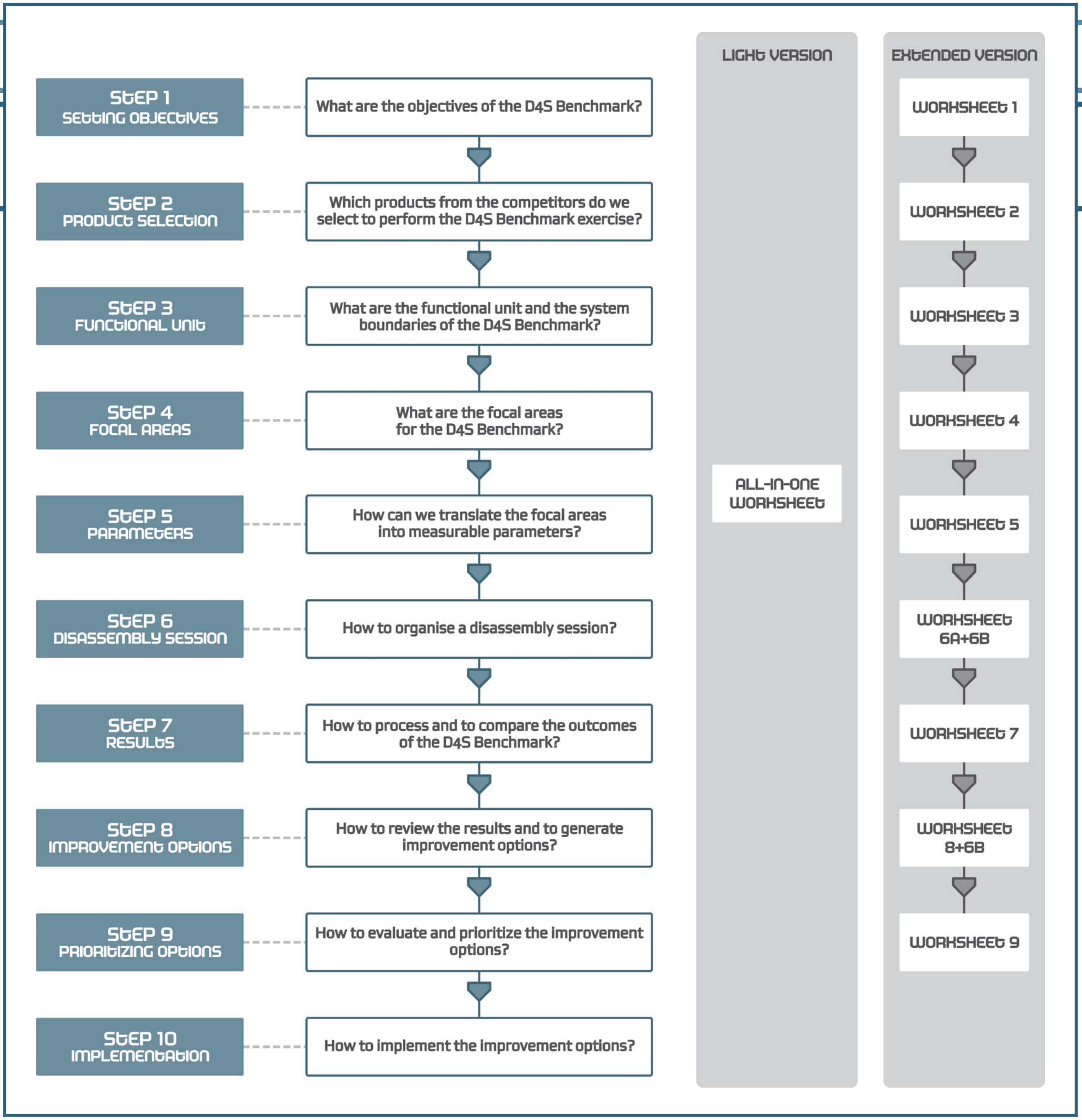
# WORKSHEETS

## ACCOMPANYING CHAPTER 6

## D4S BENCHMARKING

# D4S BENCHMARKING WORKSHEETS



| | | LIGHT VERSION | EXTENDED VERSION |
|---|---|---|---|
| STEP 1<br>SETTING OBJECTIVES | What are the objectives of the D4S Benchmark? | ALL-IN-ONE WORKSHEET | WORKSHEET 1 |
| STEP 2<br>PRODUCT SELECTION | Which products from the competitors do we select to perform the D4S Benchmark exercise? | | WORKSHEET 2 |
| STEP 3<br>FUNCTIONAL UNIT | What are the functional unit and the system boundaries of the D4S Benchmark? | | WORKSHEET 3 |
| STEP 4<br>FOCAL AREAS | What are the focal areas for the D4S Benchmark? | | WORKSHEET 4 |
| STEP 5<br>PARAMETERS | How can we translate the focal areas into measurable parameters? | | WORKSHEET 5 |
| STEP 6<br>DISASSEMBLY SESSION | How to organise a disassembly session? | | WORKSHEET 6A+6B |
| STEP 7<br>RESULTS | How to process and to compare the outcomes of the D4S Benchmark? | | WORKSHEET 7 |
| STEP 8<br>IMPROVEMENT OPTIONS | How to review the results and to generate improvement options? | | WORKSHEET 8+6B |
| STEP 9<br>PRIORITIZING OPTIONS | How to evaluate and prioritize the improvement options? | | WORKSHEET 9 |
| STEP 10<br>IMPLEMENTATION | How to implement the improvement options? | | |

# “ALL-IN-ONE” WORKSHEET

# LIGHT VERSION D4S BENCHMARKING

> *Use this worksheet if benchmark version A or B (see Chapter 6.4 and Worksheet B1) is chosen or once it is understood how a D4S Benchmarking exercise is done. It contains the most relevant information from the separate worksheets combined into one.*

| PRODUCTS IN THE BENCHMARK (FILL IN: BRANDS AND TYPE) | FOCAL AREA 1 ..................... | FOCAL AREA 2 ..................... | FOCAL AREA 3 ..................... | FOCAL AREA 4 ..................... | SMART SOLUTIONS | SILLY SOLUTIONS |
|---|---|---|---|---|---|---|
| 1_ | | | | | | |
| 2_ | | | | | | |
| 3_ | | | | | | |
| 4_ | | | | | | |
| ...... | | | | | | |

| IMPROVEMENT OPTION | ENVIRONMENTAL BENEFITS | COSTUMER BENEFITS | COMPANY BENEFITS | TECHNICAL FEASIBILITY | FINANCIAL FEASIBILITY | MANAGERIAL FEASIBILITY |
|---|---|---|---|---|---|---|
| 1_ | | | | | | |
| 2_ | | | | | | |
| 3_ | | | | | | |
| 4_ | | | | | | |
| 5_ | | | | | | |
| …… | | | | | | |

| SHORT TERM OPTIONS WITH HIGHEST PRIORITY | LONG TERM OPTIONS WITH HIGHEST PRIORITY |
|---|---|
| | |
| | |
| | |

# B1 WORKSHEET

# BENCHMARKING OBJECTIVES

|  |  |  |
|---|---|---|
| Specify **the company's product** to be benchmarked: | Brand and type |  |
|  | Functionality description |  |
|  | Main market description (Market share/market segment) |  |
|  | Description of competition |  |

|  |  |  |
|---|---|---|
| What are the main objective(s) for executing this benchmarking exercise: | A_ To learn from competition in general (worldwide) |  |
|  | B_ To know how the product scores in comparison to local competition |  |
|  | C_ To get inspiration for environmental improvements |  |
|  | D_ To know where it stands in relation to (specific) upcoming legislation |  |
|  | E_ To see if performance is improving over time |  |
|  | F_ Any other reason that may be important (specify): |  |

**If A_** In the next worksheet, make sure to include 2-3 products from global competitors, preferably from 'A-brand' multinationals.
**If B_** In the next worksheet, make sure to include 2-3 products from local competitors, preferably those that have the largest market share in the market segments that are most important to the company.
**If C_** In the next worksheet, make sure to include 2-3 products from competitors that are known to produce products with good environmental performance, that have a good environmental image, and/or that operate in an environmental niche market.
**If D_** In the next worksheet, make sure to choose products from brands that will be affected by the same legislation.
**If E_** In the next worksheet, make sure to choose products from the company's own brand's previous generations. Also, several products of the main competitor can be included in order to benchmark the rate of improvement .

> *Determine the appropriate type of D4S Benchmark for the company - light version versus extended version and information versus physical version. Indicate the selected type in the table below.*

| | BASED UPON INFORMATION OF PRODUCT OF COMPETITORS | BASED UPON PHYSICAL PRODUCTS OF COMPETITORS |
|---|---|---|
| Light version (All-in-one worksheet) | A | B |
| Extended version (10 worksheets) | C | D |

**Arguments for this selection_**

1_

2_

3_

4_

# B2

## WORKSHEET

# SELECTION OF PRODUCTS

> *Choose the products for the benchmark and describe their features following the selection criteria_*

| | OPTION: BRAND AND TYPE | FUNCTIONALITY | YEAR OF MARKET INTRODUCTION | PRICE | AVAILABILITY | MOTIVATION | OTHER COMMENTS |
|---|---|---|---|---|---|---|---|
| | Write in this column (options for) the products that will be compared with the environmental benchmark exercise | Describe briefly the main and specific features of the product, and make sure that products do not differ too much | Check if the products are more or less from the same product generation | Check if the products have (a more or less) similar retail prices | Commercial availability in terms of good, average or poor and make sure there is not too much difference | Describe motivation include product like i.e. local or international competitor, best practice, etc. | |
| 1_ | (Company´s Product) | | | | | | |
| 2_ | | | | | | | |
| 3_ | | | | | | | |
| 4_ | | | | | | | |
| 5_ | | | | | | | |
| 6_ | | | | | | | |
| 7_ | | | | | | | |
| ...... | | | | | | | |

Result of this worksheet a set of products upon which the D4S benchmarking exercise will be performed.

# B3

## WORKSHEET

# DEFINITION OF A FUNCTIONAL UNIT

> *Determine the functional unit (this is a combination of the function of the product in combination with the use scenario of the product)_*

### FUNCTION

| | |
|---|---|
| **What is the main function of the product as perceived by the user?**<br>**Describe in a qualitative and quantitative way** | |

### USER SCENARIO

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **On average the product will be used in:** | | Mode_during | | Hours a day | | Days a week | | Weeks a year | |
| | | | | | | | | | |
| | | | | | | | | | |

| |
|---|
| **Location of Use:** |

Make sure that this functional unit is taken into account when filling in the following worksheets.

# B4

## WORKSHEET

# IDENTIFICATION OF FOCAL AREAS FOR A BENCHMARK

> *Determine the focal areas for the benchmark process.*

Relevant focal areas will depend on the product to be benchmarked and the objectives of the benchmark. Relevance is reflected by product characteristics that are important_

**1>** from an objective, **scientific perspective,** e.g. causing a relatively large environmental impact;
**2>** from a **government perspective**; e.g. (upcoming) legislation;
**3>** from a **customer perspective**;
**4>** **other** reasons (which can include aspects other than sustainability).

Use this worksheet to determine the benchmark variables that are most applicable for this exercise.

| FOCAL AREA | PERSPECTIVES | | | | MOTIVATION |
|---|---|---|---|---|---|
| | Scientific | Government | Customer | Other | |
| 1_ | | | | | |
| 2_ | | | | | |
| 3_ | | | | | |
| 4_ | | | | | |
| 5_ | | | | | |
| …… | | | | | |

## B5

WORKSHEET

# DEFINITION OF BENCHMARK PARAMETERS

> *Describe measurable parameters for the focal areas.*

In many cases it will be necessary to use more than one parameter to express a single focal area.

| FOCAL AREA | TOPICS | OBJECTIVE | PARAMETER |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# B6A

## WORKSHEET

# DISASSEMBLY SESSION

> *Organize a disassembly session.*

A disassembly session is often a good idea to learn more about the target product and competitors' products and to get ideas for environmental improvement. Use this worksheet to structure the disassembly session.

### BASIC REQUIREMENTS_

A product(s) to be disassembled (preferably the company's products and some of the competitors' products)

> A balance (0.1 g precise),
> A stopwatch,
> Simple tools (to pry, cut, screw),
> A magnet,
> Pen and paper,
> (Digital) camera (to make pictures).

### OTHER USEFUL TOOLS_

Multometer (to measure energy consumption).

### STEPS BEFORE THE START_

> Make a work plan,
> Make a list of evaluation criteria for the disassembly session,
> Weigh the complete product before dismantling it,
> Measure energy consumption before dismantling it, and
> Do not forget to analyze packaging.

| Product to be disassembled | Weight of the packed products (product+packaging) | Volume of the packed products (product+packaging) |
|---|---|---|
| | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Goals of the disassembly session | | | | | | |
| | | | | | | |

| | |
|---|---|
| Evaluation criteria for the disassembly session | |
| Total disassembly time | |
| Amount of general and specific tools needed to dismantle the product | |
| Composition and amount of different kind of materials | |
| Amount of (different kind of) connections | |
| | |
| | |

## PACKAGING

| MAIN MATERIALS (PAPER, MOULDED PULP, EPS, ETC.) | WEIGHT |
|---|---|
| 1_ | Grams |
| 2_ | Grams |
| 3_ | Grams |
| 4_ | Grams |
| ...... | Grams |
| Total Weight | Grams |

| VOLUME RATIO (VOLUME PACKAGING/ VOLUME PRODUCT) |
|---|
|  |

| WEIGHT RATIO (WEIGHT PACKAGING/ WEIGHT PRODUCT) |
|---|
|  |

## ENERGY

Take in mind the Functional Unit / User Scenario as determined in worksheet B3

| MODE I.E. STAND-BY, FULL POWER | ENERGY CONSUMPTION | HOURS/DAY ACCORDING TO FUNCTIONAL UNIT/USER SCENERIO: | COSTS OF 1 KWH= |
|---|---|---|---|
| Mode 1_ | W | X | Wh |
| Mode 2_ | W | X | Wh |
| Mode 3_ | W | X | Wh |
| Mode 4_ | W | X | Wh |
|  |  | Total energy consumption per day | KWh/day |
|  |  | Total energy consumption per year | kWh/year |
|  |  | Total energy cost per day | Cost/day |
|  |  | Total energy cost per year | Cost/year |

## PRODUCT

| MAIN PARTS (IN ORDER OF DISASSEMBLY) | PARTS THAT NEED TO BE REMOVED FIRST | MAIN MATERIAL | TYPE OF CONNECTIONS TO BE BROKEN | AMOUNT | SECONDS |
|---|---|---|---|---|---|
| 1_ | | | | | |
| 2_ | | | | | |
| 3_ | | | | | |
| 4_ | | | | | |
| 5_ | | | | | |
| ...... | | | | Total Seconds | |

# B6B

## WORKSHEET

# PRELIMINARY LIST OF IMPROVEMENT OPTIONS

During the disassembly session and the other steps of the benchmark "smart solutions" of competitors and "silly solutions" in the company's own product will be encountered. It is very useful to write these observations directly down!

| ISSUES THAT ARE OBVIOUS | |
|---|---|
| Smart solutions (for example smart fastening, integration of functions, smart architecture, good material choice) | Silly solutions (incompatible materials joined, superfluous parts, glues, messy architecture, coatings, no marking of plastics) |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

# B7

## WORKSHEET

# REPORT OF BENCHMARK EXERCISE DATA

> *Summarize all benchmark findings with the help of the following table:*

| FOCAL AREA | BENCHMARK VARIABLE | DIMENSION | PRODUCT A | PRODUCT B | PRODUCT C | PRODUCT D | PRODUCT E |
|---|---|---|---|---|---|---|---|
| **Focal Area 1**<br>**Topic__** | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **Focal Area 2**<br>**Topic__** | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **Focal Area 3**<br>**Topic__** | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **Focal Area 4**<br>**Topic__** | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **Focal Area......**<br>**Topic__** | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Using a marking or a color code can help identify which product scores best for a particular focal area or from an overall perspective. For example the best scores green and the bad ones red.

# B8

## WORKSHEET

# IDENTIFICATION OF IMPROVEMENT OPTIONS

*> Review all benchmark results and identify improvement options*

One of the aims of performing a D4S benchmark exercise is to identify green improvement options. There are several ways to get triggered when identifying green improvement options. In addition to solutions that the redesign module of this manual may yield, one can think about.

**1>** Using worksheet B6 (Issues that are obvious) to identify smart solutions from competitor's products that may be improvements for the company's products.
**2>** Using the same worksheet to identify silly solutions that need improvement in comparison to a competitor's products. The competitor shows that these solutions are feasible in his case, so they are likely to be feasible in the company's product as well.
**3>** Trying to obtain a perspective on technological advancements; these could yield improvements as well. One can think about:
  **a>** alternative energy sources
  **b>** use of materials, such as plastics, with less environmental impact
**4>** Trying to look for alternatives that have not been considered before, such as:
  **a>** components and subassemblies from other suppliers
  **b>** changes in product architecture that result in less material use (wiring, integration of functions, sharing of connections)

## IMPROVEMENT OPTIONS

1_

2_

3_

4_

5_

6_

7_

8_

9_

10_

# B9

WORKSHEET

# EVALUATION AND RANKING OF IMPROVEMENT OPTIONS

> *Select the best improvement options by evaluating them against the potential benefits and feasibility.*

Each option is evaluated based on a number of criteria listed below. Criteria can be split in:
**(i)** Benefits
**(ii)** Feasibility

## BENEFITS

Let it be noted that:
**(i)** Most benefits can in principle be quantitatively assessed, but in general, various aspects will play a role in the evaluation of a single criterion, including issues that can not be enumerated using a single dimension.
**(ii)** Benefits can be of a tangible as well as of an intangible nature.

> General environmental benefits (from a societal perspective). If applicable, for this environmental perspective it may be useful to discriminate between different environmental impact categories (for example, resource perspective, emissions perspective, toxicity perspective, or for example $CO_2$ generation, (cost for cleaning up) waste generation) when improvement options affect more than one stage of the product's life cycle.

> Benefits from the customer perspective can include_
_ Money saved because of lower power consumption,
_ Less hassle,
_ More comfort,
_ Lower purchase price, or
_ More fun.
> Benefits from the company perspective can include_
_ Reduction in assembly costs,
_ Reduction in material use/costs,
_ Reduction in transportation costs,
_ Image improvement,
_ Beneficial in terms of (future) legal compliance,
_ New market potential, or
_ Higher profit margins for the product,

## FEASIBILITY

Apart from benefits, the feasibility of implementing improvement options is also important when choosing which options to implement. Improvement options may show great environmental benefits, but many practical reasons may exist why feasibility could be a problem. In general these can be divided as:

**(i) Technical feasibility**

**a_** Technology might not be present,
**b_** Knowledge might not be present in the company,
**c_** Reliability may be a problem,
**d_** Testing procedures might take too long, or
**e_** Existing company standards might be out-of-date but unlikely to change.

**(ii) Financial feasibility;**

**a_** Too big an investment is needed (changes to a production line, new facilities, new moulds too expensive, general budget limitations),
**b_** Existing contracts may prevent use of new materials/components, or
**c_** Transportation/distribution might yield problems.

**(iii) Managerial feasibility:**

**a_** Solutions might not fit in company's product development process,
**b_** Sales and Marketing departments might not want to cooperate,
**c_** Company culture might be too big an obstacle, or
**d_** Solutions can be generally perceived as too risky.

## EVALUATION MATRIX

The next worksheet can be used to get an overview of both benefits and feasibility. There are a few issues to take into account:

**>** Remember that filling in the worksheet is not a matter of absolute truth, but rather of relative scores.

**>** Remember that the main objective is to select improvement options that have the best chances to be implemented and yield benefits. This can be accomplished without exact scores.

**>** Remember to evaluate each improvement option against each criterion separately. For example, do not let the evaluation of company benefits be clouded by the financial feasibility of that particular solution.

| IMPROVEMENT OPTION | ENVIRONMENTAL BENEFITS | COSTUMER BENEFITS | COMPANY BENEFITS | TECHNICAL FEASIBILITY | FINANCIAL FEASIBILITY | MANAGERIAL FEASIBILITY |
|---|---|---|---|---|---|---|
| 1_ | | | | | | |
| 2_ | | | | | | |
| 3_ | | | | | | |
| 4_ | | | | | | |
| 5_ | | | | | | |
| ...... | | | | | | |

## RANKING IMPROVEMENT OPTIONS

The next issue is to select improvement options that have the best chance to be implemented and yield benefits. When this is accomplished, in principle the company can start working down the list as long as resources to do so remain available. For selection of the most promising improvement options it may be relevant to differentiate between short - and long - term options.

**>** Short-term options are only likely to be successfully implemented when practical considerations are sufficiently addressed. Therefore, in order for improvement options to be feasible in the short-term, the criteria ‘company benefits’ as well as all three feasibility criteria should be given sufficient weight. In this case, consideration of customer and environmental benefits is relevant.

**>** Long-term options: For selection of feasible long-term options, the environmental and customer benefits can be given more weight.